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MISCELLANEOUS EXPERIMENTS WITH CHANNEL CATFISH IN CAGES, PONDS, AND A MODIFIED RACEWAY

Miscellaneous Experiments With Channel Catfish in Cages, Ponds, and a Modified Raceway

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Abstract

Results of a series of experiments involving channel catfish (Ictalurus punctatus) are reported. In the first only very minimum differences in individual growths and rates of food conversion were found when high density (7,413 per hectare) and low density (1,483 per hectare) populations were maintained and fed in identical halves of a pond separated by a screen which permitted free circulation of water. The results suggest that it might be practical to feed out high density populations of catfish in fenced-off portions of large bodies of water that might not otherwise be manageable.

A second study measured the success of stocking channel catfish fry in 1-acre (0.4-hectare) ponds at four differing densities, and considered the practicality of providing supplementary feed at such small sizes and light densities. Rate of recovery averaged 7.4 percent higher, average total length 5.4 percent higher, and average weight 12 percent higher in fed than in unfed populations. Feeding increased survival by 22 percent, and weights of final standing crop by 76 percent.

A third study compared the efficiency of feeding catfish in cages with the feeding of equal numbers free in ponds. Higher rates of survival (97.3 vs. 70.1 %) and heavier final average weights (145 vs. 73 grams) produced final standing crops in the uncaged populations that were more than 2.5 times as heavy as those confined to cages. Differences were due in part to use of a food designed for pond catfish which did not provide the caged fish with certain elements gained by the pond fish through natural foods.

A fourth test was conducted to determine if channel catfish could be successfully reared in cages floated in a boat slip in a highly congested area of a public fishing lake. Production was not inhibited by pedestrian traffic on the dock, or by the

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passing of boats with outboard motors within a few feet of the cage because rate of gain was faster in those fish caged in the boat slip than in fish caged in undisturbed ponds.

In a final test we compared the production of channel catfish in a modified raceway containing 262.5 cubic feet (7.43 cubic meters) of raceway volume, and a flow rate of about 80 GPM, with the production obtained from feeding an equal number of fish (1250 per acre) with a demand feeder in a 1-acre (0.4-hectare) pond. Final standing crops differed by less than 1 percent, and rate of food conversion was lower in the raceway than in the pond (1.06 vs. 1.21). The high rate of flow of unscreened reservoir water through the raceway provided raceway fish with much supplementary food.

This report presents information obtained from a series of miscellaneous investigations performed over the years 1968 through 1972 at the Sam A. Parr Fisheries Research Center in Marion County, Illinois. All studies involved the channel catfish (Ictalurus punctatus). The principal studies were conducted in a series of 1-acre (0.4-hectare) ponds; additional studies were made in smaller ponds and a raceway, and in cages floated in the 585-acre (236.7-hectare) Stephan A. Forbes reservoir.

FINGERLING CHANNEL CATFISH AT DIFFERING DENSITIES IN A DIVIDED POND

Material and Methods.--Our initial experiment utilized a small (1/3-acre) (0.14-hectare), rectangular pond which was constructed to be six feet (1.8 meters) deep in the middle and shallow at each end so that a partition across the middle provided two sections which were identical in all respects except their orientation to the sun. This permitted two fish populations to be physically separated but to share water circulating through a 1/4-inch-mesh (6.4-millimeter mesh) separating screen. It was our intention to establish differing densities of fish populations in similar halves of the pond and to determine to what degree the effects of crowding the catfish might be minimized by the diluting effect of the circulating water. We believed that this would provide information as to the practicality of confining and feeding a dense population of channel catfish in a fenced-off, manageable portion of a larger and less manageable body of water. On June 19, 1968, the pond was stocked with 300 fingerlings (average total length 5.3 inches; 13.4 centimeters) in each half, equivalent to a density of 2,000 fish per acre (4,942 fish per hectare).

The fish were fed a floating catfish ration at the rate of three percent of body weight per day. After 23 days there was only 0.001 pound (0.45 gram) difference in the average weight increment made by individual fish in the two populations, indicating similar growing conditions in the two sections of the pond.

In order to establish differing densities in the similar halves of the pond, two hundred fish were seined, marked (pectoral clip) and transferred from the north to the south half. This provided 100 fish in the north half at a density of about 600 fish per acre (1,483 fish per hectare), and 500 fish in the south half at a density of about 3,000 fish per acre (7,413 fish per hectare). We could now observe the influence of the crowding and could evaluate the potential for the fencing technique. It might permit utilization of a small section of a river or a reservoir, or other "wild" waters for controlled catfish culture. Access to foods associated with the natural bottom of a fenced-off area might allow use of a less expensive feed than if the fish were confined in cages.

Results.--Results of the draining census following a growing period of 100 days are shown in Table 1. Slightly smaller average weights (0.25 lb. vs. 0.31 lb.) (114 grams vs. 139 grams) and shorter lengths (9.6 in. vs. 10.1 in.) (24.5 centimeters vs. 25.7 centimeters) of individual fish in the most crowded population indicated a small loss in efficiency, but rates of survival were higher (96 vs. 91%) and rates of food conversion lower (1.38 vs. 1.43) in the most dense population. It therefore appears that the effect of crowding was minimal, and probably not significant at the time of termination, and that additional study of the technique would seem justified. Table 1 made no distinction between marked and unmarked fish, partly for sake of simplicity, but primarily because there was no difference between marked and unmarked fish in either survival or rate of growth.

CHANNEL CATFISH FRY IN 1-ACRE (0.4-HECTARE) PONDS

Materials and Methods.--Channel catfish fry did not become available in 1968 until late July, which permitted only a rather abbreviated study. We decided to measure the success of stocking fry in 1-acre (0.4-hectare) ponds at four different densities, and to consider the value of providing supplementary feed at such small sizes and relatively light densities. When stocked on July 25, 1968, the fry had an average length of about 1 inch (2.54 centimeters), and numbered 4,082 to the pound (8,999 to the kilogram). The total stock of 38,000 fry was divided between four pairs of

Table 1.--Production of channel catfish over a period of 100 days when maintained at two differing densities in identical halves of a pond separated by a coarse-mesh screen.

Final Standing Crops

Original Stock			Numbers	
Pond Half	Number	Average Weight (Grams)	Actual	Per Hectare
South	500	30.4	481	7131 (2835.87/acre)
North	100	30.4	91	1349

Weight In Kilograms		Final Averages		
Actual	Per Hectare	Weight (Grams)	Length (Centimeters)	R.C.[1]
55.03	815.49 (28,766 oz. = 1798 #)	114.3 (4.03 oz.)	24.5 (9.6")	1.38
12.65	187.42 (413.2 #)	138.8 (4.896 oz.)	25.7 (10.1")	1.43

[1] Rate of food conversion.

ponds in the proportions of 3-5-7-9, as shown in Table 2. One of each pair of ponds received a supplemental dry food ration, fish in the other subsisted on natural foods. Feeding was at a rate of 3 to 3 1/2 percent of fish body weight per day for 5 days each week. The ponds were drained and censused in mid-October after a growing period of about 75 days.

Results.--Pertinent results for the project are shown in Table 2. Rate of recovery of original stock averaged 7.4 percent higher, average total length 5.4 percent higher, and average weight of individual fish 12 percent higher in fed than in unfed populations. Feeding appeared to increase survival, or final recovery of young by 22 percent, and pounds of final standing crop by about 76 percent. Differences in densities were apparently too small to influence rates of growth or survival.

GROWTH OF CATFISH IN CAGES VS. GROWTH IN PONDS

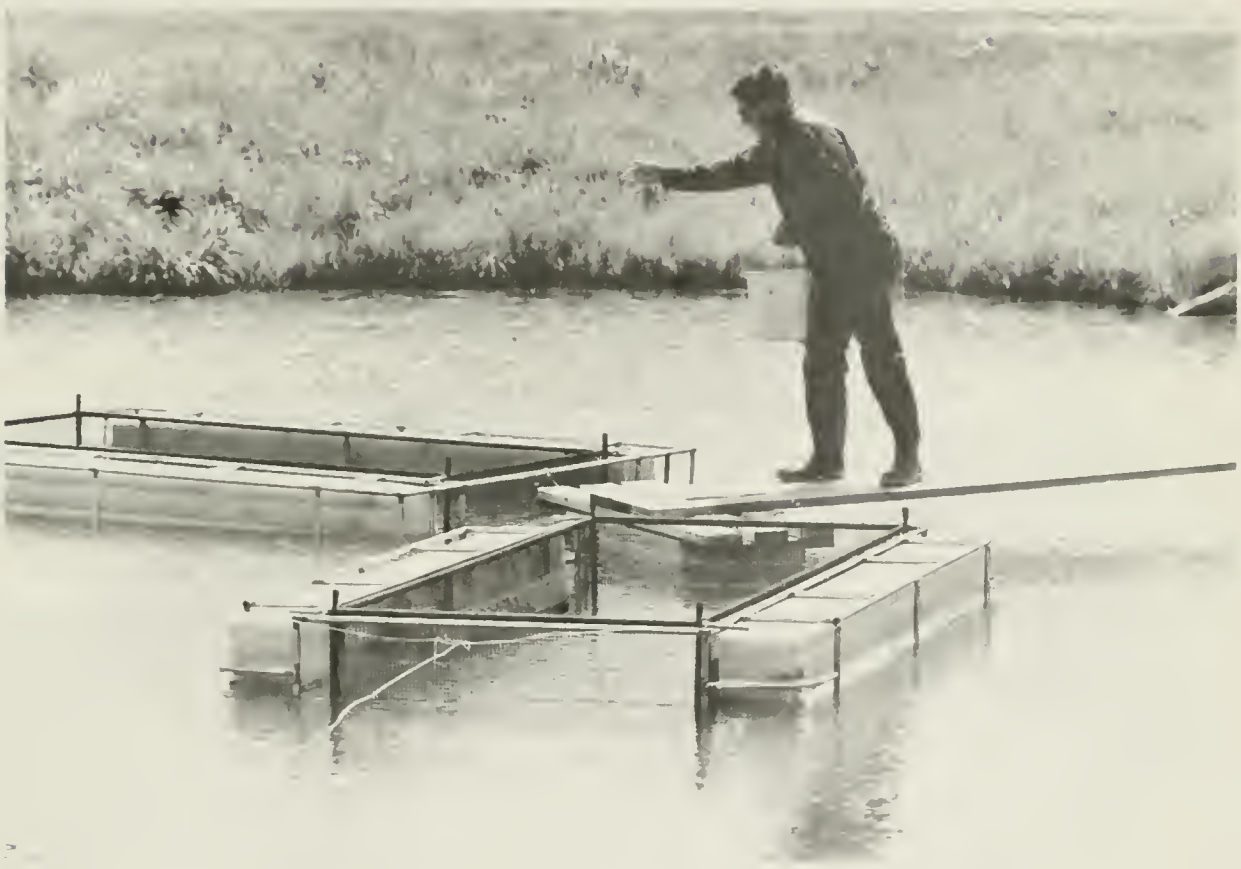
Materials and Methods.--In 1969 we compared the efficiency of feeding catfish in cages with the feeding of equal numbers free in ponds. We utilized the fish stocked as fry in the previous summer, which were now Age I, with an average length of about 5 inches (12.7 centimeters). Thinwall electric tubing and 1/2-inch mesh (1.3-centimeter mesh) hardware cloth were used to construct cages that were 9.6 feet (2.93 meters) long, 4 feet (1.22 meters) deep and 4 feet (1.22 meters) wide. The cages were floated by styrofoam so as to create a depth of about 3 feet (0.9 meter) in the cage and a water volume of about 4.27 cubic yards (3.26 cubic meters). Figure 1 illustrates the arrangement of the cages in the deep end of the 1-acre (0.4-hectare) ponds.

Four ponds were stocked with 1,500 fish free in the ponds, and four received an equal number confined at a rate of 750 in each of two cages. The fish were fed a floating catfish ration twice daily for five days each week at an initial rate of three percent of body weight per day. Late summer feeding rates were less exactly known due to high mortalities and the supplementary feeding of liver. The caged fish were sampled bi-weekly, and these weights were used to compute the ration given to both caged and uncaged populations.

Table 2.--Comparisons of production data from fed and unfed populations of channel catfish when stocked as fry at differing densities in one-acre (0.4-hectare) ponds.

	Final Census Data									
	Number Stocked		Percent Recovered		Average Length (Centimeters)		Average Weight (Grams)		Kilograms Per Hectare	
	Fed	Unfed	Fed	Unfed	Fed	Unfed	Fed	Unfed	Fed	Unfed
	2365	2365	52.9	41.6	14.0	11.7	20.4	11.3	62.82	27.30
	3956	3956	34.9	18.4	14.7	14.6	18.6	24.5	69.04	43.95
	5547	5547	45.8	79.1	11.4	10.0	10.9	7.3	68.19	78.79
	7138	7138	49.6	14.6	12.7	12.8	15.4	15.0	136.60	38.09
Means	4752	4752	45.8	38.4	13.0	12.3	16.3	14.5	82.91	47.03

Fig. 1.--Illustration of cage design and their locations in the deep ends of the 1-acre study ponds.



Results and Discussion.--The populations were censused over the period October 6-17 and the results are shown in Table 3. There were marked differences between the caged and uncaged populations in both survival and rate of growth. Rates of survival averaged 97.3 percent in the uncaged, and only 70.1 percent in the caged populations. Total lengths in inches (centimeters) averaged 10.0 (25.4) in the uncaged, and only 8.2 (20.8) in the caged populations; final average weights for uncaged fish (0.32 pounds) (145 grams) were twice as heavy as those for fish confined to cages (0.16 pounds) (72.5 grams). The combination of faster growth and higher survival produced final standing crops in uncaged populations that were more than 2.5 times as heavy as those confined to cages (460.6 vs. 173.1 pounds) (208.9 vs. 78.5 kilograms).

Poor survival and slow growth among the caged fish were believed to be due primarily to a dietary deficiency. The uncaged fish were able to supplement the pelleted rations with natural foods, while the caged fish were limited to the dry, floating rations. The food used was designed as a supplementary feed for pond catfish, and was apparently lacking some essential nutrients gained by the uncaged fish through natural foods.

No unusual behavior or signigicant mortalities were observed among the caged populations over an initial period of about 80 days, but on about August 1 mortalities increased, and behavior of the fish in certain cages changed rather markedly.

One common cause of death appeared to be mutilation of certain fish by others. In some cases large sections of muscle were removed from dorsal or lateral areas, and bones of the caudal and anal fins, or of the vertebral column, were often exposed to view, with large "flaps" of loose skin trailing behind. Mutilated fish did not appear to be either the smallest or largest, and fish so mutilated almost always died. Actual biting of one fish by another was never observed, but fine scratches believed to have been made by the teeth of an attacking fish were very much in evidence.

Two types of abnormal behavior were frequently observed among the caged fish. In one type, an occasional fish could be seen to suddenly swim very rapidly and erratically in a manner that might be described as skipping across the surface. Such activity was short-lived, ceasing as abruptly as it had begun, and the source of motivation was never evident. Also, when the cages were raised in the water to expose the fish to view, some individuals would

Table 3.--Comparison of the production of channel catfish free in 1-acre (0.4-hectare) ponds with production by equal numbers confined in cages. Data presented represent averages for four ponds with 1500 catfish free in each pond, and for four ponds with 1500 catfish divided between two cages floating in each pond. Average individual weights were 11.8 grams when stocked May 6, 7, and 8, 1969. All populations were censused in the period October 6-17 after growing periods ranging between 150 and 160 days.

Percent Survival		Average Lengths in Centimeters		Individual Wts. in Grams		Final Standing Crops in Kilograms	
Caged	Uncaged	Caged	Uncaged	Caged	Uncaged	Caged	Uncaged
70.1	97.3	20.8	25.4	72.6	145.2	78.5	208.9

become completely inert and hang limply in the hand while being inspected. Such fish recovered slowly when returned to the water.

Lewis (1969) observed what he called fighting, with consequent mutilation among catfish when stocked in cages at densities of less than 50 to 75 fish per cubic yard (65 to 98 fish per cubic meter), and recommended stocking cages at a density of 150 fish per cubic yard (196 fish per cubic meter) to eliminate this problem. Collins (1970) used cage densities of 160 per cubic yard (209 per cubic meter) with no fighting or mulilation, and Schmittou (1969) used densities as high as 382 fish per cubic yard (500 fish per cubic meter) with no loss attributed to mutilation of one fish by another. Our cage densities were in the range of 180 to 185 fish per cubic yard (235 to 242 fish per cubic meter). In our case, however, mutilation occurred quite erratically and was not the principal cause of death. For example, mutilation of fishes was much more prevalent in cages suspended in ponds 1 and 5 than in pond 2, but pond 2 fishes had a higher rate of mortality (46.1%) than those in either pond 1 (21.0%) or pond 5 (36.6%).

In an effort to more clearly define the problem, we decided to add beef liver to the diet of some fish, and to increase the density of others. A divider was placed in one cage in each of ponds 1 and 5 so that the fish were crowded into an area having 2/3 of the former volume. These fish were fed the normal ration, with no liver. In the remaining cage in each of these ponds the fish were maintained at their former density and their pellet diet was supplemented by a substantial amount of beef liver. In 14 days it became clear that less mutilation was occurring among the liver-fed fish than among the more crowded fish, and all caged populations were placed on a liver diet. The series of observations seemed to indicate that the problem was more one of diet than of density, and this seemed to be confirmed in our later study in which caged populations receiving Purina trout chow, a more complete diet, exhibited no fighting or mutilation in any of the caged populations.

CAGED CHANNEL CATFISH IN PUBLIC FISHING WATERS

Materials and Methods.--We conducted a test to determine if channel catfish could be successfully reared in cages floated in a congested area of a public fishing lake. A cage of 1/4-inch-mesh (6.4-millimeter mesh) hardware cloth was suspended in a boat slip in the center of a complex of docks in 585-acre (236.7-hectare) Stephen A. Forbes reservoir where both pedestrian and boat traffic passed within a few feet (meters) of the cage. The cage was 8-feet

(2.44 meters) square and 6-feet (1.83 meters) deep, suspended to provide a cage depth of about 3 1/2 feet (1.07 meters). The cage was divided by 1/4-inch-mesh (6.4-millimeter mesh) hardware cloth to provide two equal compartments. On May 16, 1969, one compartment was stocked with 780 individuals having a total weight of 196.6 pounds (89.2 kilograms), a mean weight of a 0.25 pounds (114 grams); the other compartment received an equal number of a smaller size. To provide a basis for comparison, smaller cages were placed in two ponds (numbers 10 and 12) and stocked with fish of the same size as the largest used in the lake, and at the same cage density. Sufficient additional fish were released into these small ponds to raise the total density within the ponds to a level of 1,500 fish per acre (3,707 fish per hectare). All populations in this test were fed the same rations used for the caged populations in our 1-acre (0.4-hectare) ponds.

Results.--The fish in the cage in Forbes Lake began to mutilate one another, and to show an increased mortality, after the same time interval (about 80 days), and in an identical fashion, to the caged fish in two of our 1-acre (0.4-hectare) ponds. Surprisingly, however, mutilation was not observed, and mortality rates were much lower in cages floated in ponds 10 and 12, than in the fish caged in the lake. Because of the late season loss of weight and high mortalities among the fish caged in the lake, we found that weights recorded from the populations in August, before the mortalities occurred, provided the best basis for comparison. In Table 4 we may see that the larger of the two sizes of fish caged in the lake had an average weight of 0.81 pounds (366.5 grams) on August 13, compared to weights of 0.65 and 0.59 pounds (294 and 268 grams) in ponds 10 and 12 respectively, at the later date of August 27. Thus, growth was apparently not inhibited or limited by the pedestrian traffic on the dock, or by the passing of boats with outboard motors in this most congested area of the lake. In two subsequent tests under the same conditions it was established that good growth and survival could be obtained, and "fighting" eliminated, by use of a more complete feed, but the feeding was done by others and the feeding rates not sufficiently controlled to provide quantitative data. Fish from these tests released into the lake were quite readily caught by anglers, but creel records could not be obtained.

Table 4.--Comparisons of growth of caged channel catfish in a heavy-use boatdock area of a 585-acre (236.7-hectare) reservoir with growths made by catfish maintained at equal cage densities in undisturbed small ponds. The numbers of uncaged catfish released into the ponds raised the total densities to approximately 3,707 channel catfish per hectare.

Location of Cage	Mean Weights in Grams On Dates Indicated				Mean Gain per Fish in Grams in Number of Days Indicated
	Initial		Final		
Forbes Reservoir (236.7 hectares)	May 16	114.3	Aug. 13	366.5	252.2 in 89 days
Pond 10 (0.10 hectare)	May 29	115.7	Aug. 27	294.4	178.7 in 90 days
Pond 12 (0.14 hectare)	May 19	109.8	Aug. 27	268.1	158.3 in 100 days

Our original test in 1969 was conducted with the thought that the technique might present a practical and relatively economical method for improving the quality of fishing in public waters, and subsequent developments in Iowa suggest that this may be true. Conley (1972) has reported on a program wherein the Iowa Conservation Commission provides fingerling channel catfish to County Conservation Boards for rearing in cages and eventual release into the County-owned lake in which they were reared. The program was initiated in 1971 in 25 lakes having a total acreage of 2,500 acres, (1,012 hectares) and preliminary evaluations encouraged expansion of the program. Success in terms of returns to anglers is not yet fully known, and will be a matter of great interest.

CHANNEL CATFISH PRODUCTION IN A MODIFIED RACEWAY

Materials and Methods.--All of our 1-acre (0.4-hectare) ponds drain into a cement "catch basin" that has an effective holding area 12 feet (3.66 meters) long and 7 feet (2.13 meters) wide. Between draining operations the basin can be used as a holding tank, or as a modified raceway. On June 2, 1972, the basin was stocked with 32.8 pounds (14.9 kilograms) of 4-inch (10-centimeter) catfish (about 1,575 in number). The basin was maintained at a depth of 38.5 inches (0.98 meter) with water gravity fed directly into the basin from a 585-acre (236.7-hectare) reservoir at a rate of approximately 80 gallons (303 liters) per minute. This rate of flow provided a complete exchange of water in the basin approximately once every 25 minutes. The water entered the basin below water level and a 1/4-inch (6.4-millimeter) screen was placed over the outlet pipe to prevent the fish from entering the line. The initial stocking rate was at a density of about 6 fish per cubic foot (212 per cubic meter). On July 12, 1972, 150 fish weighing 11.6 pounds (5.28 kilograms) were removed, leaving a density of about 5 fish per cubic foot (177 fish per cubic meter). Twice daily, for 5 days each week, the fish were fed all of the Purina trout chow that they would consume in 5 minutes. At the time of harvest this daily ration was found to be 1.9 percent of the weight of the fish. Final census occurred on September 28 after a growing period of 118 days. Over a slightly longer period (132 days), a similar number (1,250) of fish of the same initial size were maintained in a 1-acre (0.4-hectare) pond and fed a sinking ration from a demand feeder. This pond was also stocked on June 29 with a large "spawn" of channel catfish fry which were fed a starter meal.

Results.--Pertinent results from the two populations are compared in Table 5. It was both a surprise and a disappointment that the pond fish, which presumably had all they desired to eat at all times, attained a total weight of only 226.6 pounds (102.28 kilograms). The 234.5 pounds (106.36 kilograms) of food which passed through the demand feeder (conversion 1.21) was supplemented by the normal pond organisms, plus an unknown number of the co-existing fry. Since only approximately 700 Age 0 catfish were recovered out of an original stocking of a large spawn, predation of these small fish could have been substantial; however, a conversion rate of 1.21 indicates that no large amount of the pelleted food was wasted. It would seem to be significant that as many pounds of fish were produced in 262.5 cubic feet (7.43 cubic meters) of raceway volume as in the 1-acre (0.4-hectare) pond, and in a lesser number of days. On the basis of results reported by Allen (1972), production in the raceway might well have been larger with a more efficient balance between stocking density and rate of flow. In a series of experiments in 420-gallon (11.89 cubic meter) tanks, Allen (op. cit.) attained standing crops as high as 5.7 pounds per cubic foot (91.3 kilograms per cubic meter), finding that the most efficient use of his facilities was obtained at a stocking density of 10 fish per cubic foot (353 fish per cubic meter), and a flow rate of 4.5 gallons (17.03 liters) per minute. Flow rates of 12.5 GPM (47.32 liters per minute) were found to have an adverse effect on net production when combined with densities of 5 and 10 fish per cubic foot (177 and 353 fish per cubic meter). Our flow rate of 80 GPM (303 liters per minute) may have reduced production substantially below what might have been obtained at a more optimum flow rate.

On the basis of known amounts of the pelleted food presented to the fish, conversion rates were 1.21 in the pond, and 1.06 in the raceway. A rate as low as 1.21 in the pond was not unexpected because of the availability of a supplementary diet of catfish fry, crayfish, and other natural foods. The lower rate of 1.06 in the raceway indicates that the amount of natural food which entered the catch basin in the continuous flow of lake water must have been large. The source of this water was a 10-inch (25.4-centimeter) intake pipe located in the reservoir at a depth which varied between 3 and 5 feet (1 and 1.5 meters) over the period of study. Many forms of aquatic life, including small fish, crayfish, a large variety of insect larvae, and occasional heavy loads of zooplankton were known to pass through this supply system. When pelleted rations are supplemented by the quantity of natural food that is believed to have entered the catch basin raceway, it would probably be possible to use a less complete and less expensive food than required when the water is filtered, or originates from a well.

Table 5.--Comparisons of rates of production of channel catfish in a raceway and a 1-acre (0.4-hectare) pond.

Habitat	Weight in Kilograms		Growing Period	Conversion of Artifical Food
	Original	Final		
Raceway	14.88	102.62	118 days	1.06
Pond	15.12	102.78	132 days	1.21

SUMMARY

1. Channel catfish were stocked and fed at densities of 3,000 and 500 fish per acre (7,413 and 1,483 fish per hectare) in the similar halves of a pond divided by a coarse-meshed screen which permitted free circulation of water. Minimal differences in growth in the two populations suggests that it may be practical to confine and feed a dense population of catfish in a fenced-off, manageable portion of a larger and less manageable body of water.

2. We measured the success of stocking 1-inch (2.5-centimeter) channel catfish in 1-acre (0.4-hectare) ponds at densities ranging from 2,365 to 7,138 per acre (5,844 to 17,638 per hectare), and considered the value of providing supplementary feed to fish in such small sizes and light densities. Over a 75-day period rates of survival in individual ponds ranged from 14.6 to 79.1 percent. Feeding increased survival by about 22 percent, and pounds of final standing crop by 76 percent.

3. We fed 1,500 channel catfish in each of four 1-acre (0.4-hectare) ponds and 1,500 catfish confined in two cages (175 fish per cubic yard, or 230 per cubic meter) in each of four other 1-acre (0.4-hectare) ponds, in order to compare the efficiency of the methods. The fish were fed five days each week over growing periods ranging from 150 to 160 days in individual populations. Rates of survival averaged 97.3 in the uncaged, and only 70.1 percent in the caged populations. Fish free in the ponds averaged approximately 25 percent longer and 119 percent heavier than those confined in cages. Final standing crops of uncaged populations were more than 2.5 times as heavy as those populations confined to cages. Production failures of catfish in cages were attributed primarily to dietary deficiencies through use of a feed designed to supplement the natural food in ponds.

4. In 1969 we conducted a test to determine if channel catfish could be successfully reared in cages floated in a congested area of a public fishing lake. The cage was suspended in a boat slip in the center of a complex of docks where both pedestrian and boat traffic passed within a few feet (meters) of the cage. Gains by the fish caged in the congested area were sufficiently greater than those made by fish caged in two small, undisturbed ponds as to establish that growth was not inhibited or limited

by either passing people or outboard motors. The fish were readily caught following their release into the lake, and the technique holds promise as a practical means for improving the quality of fishing in such public waters.

5. Similar numbers and weights of 4-inch (10.2-centimeter) channel catfish were stocked in a 1-acre (0.4-hectare) pond at a rate of 1,325 fish per acre (3,274 per hectare) and in a modified raceway at a rate of 5 fish per cubic foot (177 per cubic meter). Raceway flow was about 80 gallons (303 liters) per minute, providing a turnover about once every 25 minutes. Pond fish were fed a sinking ration from a demand feeder; raceway fish received all of the Purina trout chow they would eat in 5 minutes twice daily for 5 days each week. In a volume of only 262.5 cubic feet (7.43 cubic meters) the raceway fish had a superior conversion ratio (1.06 vs. 1.21), and in 118 days produced a standing crop as large as that produced in the 1-acre (0.4-hectare) pond in 132 days.

LITERATURE CITED

Allen, Kenneth O. 1972. Factors affecting growth and survival of catfish reared in tanks. Presented at the Catfish Research Workshop, Fourth Annual Convention Catfish Farmers of America, Dallas, Texas. Mimeo, 5 pp.

Collins, Richard A. 1970. Cage culture of catfish in reservoir lakes. Presented at the 24th Annual Convention of the Southern Division of the American Fisheries Society and Southeastern Association of Game and Fish Commissioners, Atlanta, Georgia. September, 1970. 11 pp.

Conley, Jerry M. 1972. Catfish rearing. Farm Pond Harvest 6(3):17-20.

Lewis, William M. 1969. Progress report on the feasibility of feeding-out channel catfish in cages. Report of the Fisheries Research Laboratory, Southern Illinois University, Carbondale, Illinois. Mimeo, 8 pp.

Schmittou, H. R. 1970. Developments in the culture of channel catfish, Ictalurus punctatus (Rafinesque), in cages suspended in ponds. Southeastern Association of Game and Fish Commissioners Proceedings for 1970. 44 pp.

Legends for Tables and Figures

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Table 2.--Comparisons of production data from fed and unfed populations of channel catfish when stocked as fry at differing densities in 1-acre (0.4-hectare) ponds.

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Table 5.--Comparisons of rates of production of channel catfish in a raceway and a 1-acre (0.4-hectare) pond.

Figure 1.--Illustration of cage design and their locations in the deep ends of the 1-acre study ponds.

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